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(54) Luminous diffused light panel with low energy consumption and limited thickness

(57) Luminous diffused light panel with low consumption and low thickness, useful for luminous advertising signs, way signs, traffic marks, furnishing elements etc. consisting of a first light conducting plate (1) in transparent material, covered on its rear side with a white paint coating (6) or with a glued or adhesive film, consisting of linear led assemblies (2) fitted on one, two or more edges of the above mentioned transparent plate (1), resting on suitable supports (3) usually represented by sequenced energized printed circuits, consisting of elements (5) reflecting the light of the led's located between the supports (3) and the polished edge of the transparent plate (1), consisting of a second opaline transparent plate (7), diffusing the light coming from the surface of the above mentioned plate (1), consisting of a third protective plate (8), positioned in front of the second plate (7), and useful for settling the signs to be illuminated, and consisting of suitably shaped sections (9) framing the four sides of the plates (1, 7, 8) and the led's (2) apt to form a peripheral frame (9) completed at its corners by corner caps (10).

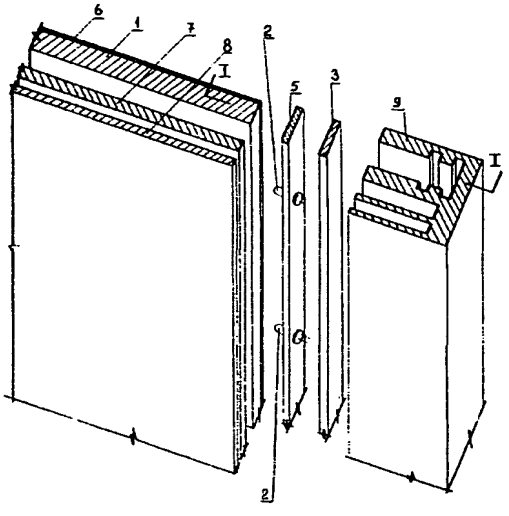

Fig 1

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Description

[0001] Lighting systems for luminous advertising panels, way signs, traffic marks, furnishing elements etc. are widely spread in connection with visual communication development which shall be effective even during evening and night hours and in zones not exposed to day light.

[0002] There are plentiful examples of these lighting systems.

[0003] Some known systems are located on the outsides of the signs to be illuminated so that the signs or indications are visible by reflected light.

[0004] For example, internally lighted signs are also known, usually formed by neon lamps mounted inside a container provided with an opaline plate bearing on its surface the indications or signs which are usually in transparent and coloured material.

[0005] These internally or externally illumination of marks and signs achieved with normal neon lamps shall , however, be directly powered from the mains because of their high consumption rate.

[0006] To remedy this drawback of the lighting system, it is sometimes possible to replace the neon lamps of internal lighting systems by LED's (light emitting diodes). These led's are fitted inside the container where they are forming the required signs or words with the utilisation of rays of light emitted by the led's positioned side by side so as to form the word or imagine.

[0007] These led's have a high brilliancy, low electric energy consumption and a long average life of about one hundred thousand hours.

[0008] Panels are known that are completely covered by led's which are energized in different modes so as to form different images or words. in these applications, the opaline plate may be replaced by a transparent plate.

[0009] This led application system offers a considerable economic advantage, especially regarding consumption with the possibility for the human eye to read at a distance of about 150 m.

[0010] This led lighting system has, in turn, the serious drawback in that it requires a great number of led's , emitting - as is known - a rather concentrated light; furthermore the already known led systems permit to form a specific image and to change this image it will be necessary to change the arrangement of the led's inside the container or will require at least a great number of led's to be energized in different ways.

[0011] This invention has the aim to obtain a luminous diffused light panel characterized by low energy consumption and limited thickness, requiring only a limited number of led's.

[0012] According to this invention, the luminous panel consists of a plate assembly and accessories implemented as follows.

[0013] The first plate consists of transparent material, for instance metacrylate, polycarbonate, glass, crystal or any other light conducting material, provided along one, two or more of its edges with a linear led assembly mounted on a suitable support and sequence energized.

[0014] This support may be a printed circuit and a reflecting element, further securing the perfect positioning of the led's, is inserted between the support and the polished edge of the plate.

[0015] The back side of this first transparent plate is prepared to reflect and diffuse the led emitted light by covering this surface with a white paint coat or with a glued or adhesive film of suitable thickness and material. This first plate is usually flat but it may also be curved. In this way, the light of the led's propagates through the light conducting plate and reflects on the paint or film, coating its back surface, thus diffusing the light outwards.

[0016] A second opaline plate, placed at a few millimeters from the first transparent plate, will further diffuse the light from its surface at an extraordinary high emission uniformity. The latter plate may be replaced by two plates having a lower opacity grade but which will be positioned nearer to the first plate so as further to reduce the thichness of the luminous panel.

[0017] A third protective plate in transparent material will be placed in front of the second plate at a few millimeter distance or will be resting on the second plate, while another protective plate, which needs not be transparent, may be placed behind the first plate.

[0018] The luminous panel thus described will diffuse the light only from the second opaline plate surface.The case is also considered in which a luminous panel diffuses the light from both sides. In such case, the white paint or film is applied in alternating and staggered strips or with other schemes on both surfaces of the first light conducting plate thus causing the light to be reflected and diffused froth both sides of the first plate. The luminous panel is then equipped with two (or four) opaline plates, one on each side and also with two transparent protective plates one on each side. The plate and led assembly together with their supports are mounted in a structure of aluminium sections or in other plastic material fitted on the four sides of the plates, which will thus form a peripheral frame, the corners of which are finished with corner caps screwed onto the sections. If required, proper electronic components will be provided for grounding and protection of the luminous panel against overvoltage and electrostatic discharge.

[0019] The peculiar arrangement of the led's, the special plate sequence and the particular aluminium or plastic sections will permit to reduce the panel thickness to about 50 mm against the 130 mm thickness of known panels internally lighted by neon lamps.

[0020] Such luminous diffused light panels of limited thickness and low consumption rate, preferably equipped with two series of lateral led's, will be able, for instance, to illuminate an advertising sign at low energy consumption. It is also suitable to illuminate identifica-

tion panels of any kind, such as traffic signs, radiograph reading devices as well as luminous panels for furnishings, consoles and luminous surfaces.

[0021] The notices or indications to be highlighted may be printed or serigraphed on the outer surface of the opaline plate or on the internal surface of the transparent protection plate or on a translucid film inserted between the two above mentioned plates.

[0022] As by a first solution as explained, the supporting and the reflecting element of the Led's are mutually independent and are kept in place by properly shaped framing sections.

[0023] This arrangement is practical for panels of limited size, while for large sized panels, the alignment of the supporting sections, the reflecting elements and therefore of the Led's may sometimes be difficult.

[0024] This drawback is eliminated, according to this new invention, by manufacturing the supporting structure, consisting of the printed circuit, and the reflecting element so that they can be assembled before they are fitted into the section frame which is modified in order to permanently lodge the above mentioned supporting structure and the reflecting element.

[0025] According to the above description the first transparent plate surrounded by the leds has one surface covered with a white paint coat or with a glued or adhesive film diffusing the light which propagates through the other, non-coated surface of the plate.

[0026] In some cases, especially for large sized panels, the light intensity at the centre of the panels i.e. further away from the peripheral led's, may be lower due to the fact that the light is mainly diffused in the peripheral zones and is attenuated in the central zones. In these cases light diffusion can be much improved, according this invention, if the surface of the first transparent plate generating diffused light on one side only is treated, instead of being uniformly coated with paint or a film, so as to create a geometrical pattern on this surface determined by alternating areas reflecting the light to the opposite panel surface and non-treated areas allowing the light to propagate through the plate. The light intensity in the centre of the plate will thus be improved and light diffusion through the whole plate surface will become more uniform.

[0027] The reflecting surface areas may be obtained by the application of materials such as paints, serigraphy inks, transparent or opaque adhesive films or even by chemical etching using solutions reacting with the plate surface, or by chipping or roughing processes or sand blasting or in the case of plates in plastic material, by thermal deformation.

[0028] For exemplification purposes, ink deposited by serigraphy on suitably spaced parallel strips of a few millimeter width will yield excellent results.

[0029] However the pattern may be widely varying: it may be linear (lengthwise, transverse or diagonally with respect to the light emitted by the led's), chequered, spiral formed or differently dimensioned so as to create a nuanced light diffusion.

[0030] An additional advantage of this method regarding treated and non-treated areas is that the second opaline plate, used to obtain a better light diffusion, may be placed nearer to the light emitting side of the first transparent plate which is surrounded by led's, without generating halations or less luminous areas. This is an obvious improvement with respect to the above mentioned solution.

[0031] As for lighting panels in which the light is diffused from both sides, the process selected from those indicated above has to be alternatively performed on both sides of the first transparent plate, obviously in alternate pattern: for example, the serigraphed stripes on one side shall be matched by a non treated area and shall therefore be transparent on the other side.

[0032] The invention in question is illustrated in its exemplar solutions in the enclosed drawings in which:

[0033] Fig.1 shows an exploded partial view of the luminous panel, featuring one of its sides equipped with led's.

[0034] Fig.2 shows a frontal view and partial section of the luminous panel assembly.

[0035] Fig.3 shows a partial frontal section of the panel assembly according to I-I of fig.1.

[0036] Fig. 4 shows a partial section of the panel according to II-II of fig.2 the light being diffused on one side only of the panel.

[0037] Fig.5 shows a partial section of the panel according to II- II of fig.2 in a solution where the light is diffused on both sides of the panel.

[0038] Fig.6 shows an exemplified solution of a pole mounted sign equipped with a photovoltaic cell module and accumulators.

[0039] Fig 7 shows a side and partial section view according to III-III of Fig.8 of a varied panel subject matter of this invention, in the solution by which the light is diffused on one side only.

[0040] Fig.8 shows a partial front view of the panel.

[0041] Fig.9 shows a cross section of a printed circuit supporting the Led's.

[0042] Fig.10 shows a cross section of an exemplified element reflecting the Led emitted light.

[0043] Fig.11 shows the assembly of the support of Fig.9 and the reflecting element of Fig.10.

[0044] Fig.12 shows the section of the exemplified panel where it matches the framing section of the first transparent plate through which the light is diffused on one side only.

[0045] Fig. 13 shows the section of an exemplified panel where it matches the framing section of the first transparent panel through which the light is diffused on both sides.

[0046] With reference to the above figures, the luminous panel according to this invention, consists of a plate assembly complete with its accessories set up as follows.

[0047] It consists of a first plate 1 in transparent ma-

terial of suitable thickness, such as for instance metacrylate, polycarbonate, glass, crystal or any other appropriate light conducting material, this first plate 1 being equipped for instance on at least two sides with a linear led assembly 2, mounted on a proper support 3 and conveniently sequence energized. This support 3 may be a printed circuit fitted with power balancing resistors 4 while one or more reflecting elements 5 are inserted between the printed circuit 3 and the polished edge of the first plate 1 so that these elements 5 reflect the light towards the edge of the plate 1 and will also further secure the perfect positioning of the led's.

[0048] The back surface of the first plate 1 has been prepared to reflect and diffuse the light emitted by the led's by means of a white paint coat 6 or by the application of a glued or self-adhesive film of suitably material and thickness.

[0049] This first plate 1 has usually a flat configuration but it may also be curved.

[0050] In this way, the led emitted light propagates insides the light conducting plate, reflecting on the paint coat or film applied on its rear surface and will spread outside.

[0051] A second opaline plate 7, placed at a few millimeters distance from the first transparent plate 1, will further diffuse the light from the plate surface, at an extraordinary uniform emission rate. This plate may also be replaced by two plates with lower opacity but positioned nearer to the first plate so as further to reduce the luminous panel thickness.

[0052] A third protective plate 8 in transparent material is placed in front of the second plate 7 at a few millimeter distance, while another protective plate, which needs not be transparent, may be placed behind the first plate.

[0053] The luminous panel described and illustrated in the figures 1 thru 4 diffuses the light only from the side of the second opaline plate 7 and of the third protective plate 8.

[0054] The case of a luminous panel is also considered, where the light is diffused from both sides as illustrated in fig.5. In such case, the white paint coat 6,6' or film is applied in alternating and staggered strips or with another configuration, on both sides of the light conducting plate 1, thus causing the light to be reflected and diffused on both sides of this first plate. The luminous panel is then equipped with two (or four) opaline plates 7, 7' one (or two) on each side and also with two protective transparent plates 8,8', one on each side.

[0055] The four sides of the panel assembly, complete with led's and supports are mounted in suitably shaped sections 9 in aluminium or in plastic material thus forming a peripheral frame, the corners of which are fitted with angle caps 10 screwed or otherwise secured to the sections 9.

[0056] If necessary, proper electronic components and earthing connections will be provided to protect the luminous panel against overvoltage and electrostatic discharge.

[0057] As already explained, the peculiar positioning of the led's, the particular plate sequence and special aluminium or plastic sections will permit to obtain luminous panels of greatly reduced thickness as compared with known panels.

[0058] Obviously, for exemplification purposes as indicated in the drawings, two led series 2 are positioned on opposite sides of the first plate 1, but it is also possible to place only one led series on one side, or additional led series on one or both of the other two opposite sides.

[0059] Thus, the led emitted light penetrates through the first transparent plate from one, two or more sides, spreading in the assembly, while being reflected and diffused towards the outer surface by means of the opaque white paint coat or of a suitable film, thus reaching the opaline plate 7 which will diffuse the light in uniform brightness. The notices or indications to be highlighted may be printed or serigraphed on the outer surface of the second opaline plate 7 or on the internal surface of the third transparent protection plate 8 or on a translucid film inserted between the two above mentioned plates.

[0060] Obviously, chromatic variations are also possible, such as for instance coloured and transparent texts on opaque background or vice versa.

[0061] The printed circuits, plates and reflecting elements are mounted, as described before, in properly shaped aluminium or plastic sections 9 fitted on the four sides of the plates and connected by corner caps 10 or screwed or otherwise secured to the sections 9 so as to create a peripheral frame and to obtain a sturdy and rigid panel structure. The panel can then be pole, flag or wall mounted or otherwise installed as deemed appropriate.

[0062] Fig. 6 shows an example of a pole mounted warning panel 11, completed by batteries 12 powered by a photovoltaic cell generator 13. However, whenever possible, the led's 2 may also be powered by the mains.

[0063] According to this invention, the solution as by figures 4,5 is modified by assembling the support 3 of the Led's 2 and the reflecting element 5 before their installation with restrained joints 14 and eventual set screws 15 or other locking device. The two assembled elements illustrated in fig. 11 are fitted in a suitable framing section 16 as illustrated in fig.12.

[0064] As said before, a sequence of Led's, supports and reflecting elements perfectly aligned along the edges of the first plate is thus obtained and this is particularly advantageous for large sized panels.

[0065] According to this invention as illustrated in the figures 7 though 12, the uniform light diffusion through one surface of the first plate 18 is improved by replacing the white paint and self-adhesive film by processing operation so as tocreate a geometrical pattern on the light diffusing surface, this pattern being determined by alternating areas reflecting the light towards the opposite side and non treated areas through which the light freely flows inside the plate. The surface portions featuring al-

ternating light reflecting patterns can be obtained by application of materials, such as paints, serigraphy inks, transparent or opaque films or by chemical etching or chipping or sand blasting.

[0066] The alternating patterns of the reflecting surface may have any linear, helical and variable design.

[0067] Another solution for improvement according to this invention is illustrated in Fig. 13, featuring a first transparent plate 18, the outer surfaces 19, 19' of which have been provided with alternating patterns (e.g. alternating stripes).

[0068] This solution in which the first plate 18, where both surfaces 19, 19' are featuring alternating patterna, offers the significant advantage of a virtually perfect light diffusion from the first plate 18 so that the second opaline plate 7, 7' and the third protective plate 8, 8' located on both sides of the first transparent plate 18 may be approached nearer to hte transparent plate 18, thus greatly reducing the size and particularly the thickness of the panel assembly.

[0069] By the solution, the section frame 20 is properly changed as illustrated in fig. 13.

[0070] In any case, the sections of the frame 16 and 20 and the other accesory elements normally feature properly bright polished inner surfaces so as to ensure the most efficient diffusion of the Led emitted light. The external edges of the first plate 1, 18 may also be bright polished for the same purposes.

[0071] In the above fig. 13 the panel is emitting the light from both sides, but if light emission is required from one side only, the geometrical pattern is worked on one side only while the other side of the transparent plate 18 is darkened by means of a blind wall preferably in paint coated aluminium, positioned in substitution for the second opaline plate 7 and the third protective plate 8.

[0072] The utilization of the luminous diffused light panel subject matter of this invention allows for a vast application range , so that it may have various dimensions and configurations based upon the function to be fulfilled.

[0073] The luminous diffused light panel of limited thickness and low consumption may be used to illuminate advertising signs, traffic signs, road condition signs, courses for cars, cyclists and walk ways , signs inside and outside buildings, signs for bus and taxi stops , radiograph reading devices, luminous panels for furnishings, consoles with luminous surface and many other applications to draw the attention to a surface, an object or indication by the emission of diffused light.

[0074] Obviously, according to this invention, other solutions may be envisaged by which the first transparent plate 1, 18 is properly coated with mat or glossy white paint or with a film or is processed to obtain an alternating geometrical pattern, or is featuring one or more transparent films sticking to one or both surfaces of the first transparent plate 1, 18 and on one or more second opaline plates followed by a third transparent plate 8, while keeping in mind that all these solutions can utilize the frame sections 16, 20 adjusted to the various needs by means of proper jointings 21.

Claims

1. Luminous diffused light panel of limited thickness and low consumption which may be used to illuminate advertising signs, traffic signs, road condition signs, car lanes, cyclist paths and walk ways, signs inside and outside buildings, signs for bus and taxi stops, radiograph reading devices, luminous panels for furnishings, consoles with luminous surface and many other applications to draw the attention to a surface, an object or indication by the emission of diffused light, **characterized in that** it is made up of :

   - a first plate (1) in transparent material of suitable thickness, such as for instance metacrylate, polycarbonate, glass, crystal or any other appropriate light conducting material,
   - linear led assemblies (2) resting on suitable supports (3) and properly sequence energized , these linear led assemblies being mounted on one, two or more edges of the first transparent plate (1) while the support (3) is represented, for exemplification purposes, by a printed circuit fitted with the necessary resistors (4) to balance the electric power supply,
   - one or more reflecting elements (5) inserted between the printed circuit and the polished edge of the first plate (1) to reflect the led emitted light towards the edge of the plate (1) and to guarantee a perfect positioning of the led's,
   - a white paint coat (6) or a proper glued or self-adhesive film applied to the back side of the first plate (1) so as to reflect and diffuse the led emitted light outwards, through the other side of said first plate (1),
   - a second opaline plate (7), placed at a short distance from the first transparent plate (1), for further diffusion of the light emitted from the surface of the first plate (1),
   - a third protective plate (8) in transparent material, placed at a proper distance in front of the second plate (7) or resting against this plate (7), particularly useful to bear the signs, indications, drawings and notices to be highlighted;
   - properly shaped framing sections (9) in aluminium or plastic material fitted on the four sides of the plates (1, 7,8) and of the led's (2) to form a peripheral frame finshed by corner caps (10) screwed or otherwise secured to the framing sections (9),
   - writings, notices, drawings and/or other indications, where necessary, to be printed or serigraphed on the outer surface of the second

opaline plate (7) or on the inner surface of the third transparent protective plate (8) or obtained by using a translucid film inserted between the two plates (7, 8),

so as to obtain luminous panels of different nature and for various applications to be mounted on poles, walls or as otherwise required.

2. Luminous panel as described in claim 1, **characterized in that** the first plate (1) and hence all other plates (7,8) as well as the general form of the panel are flat or properly curved.

3. Luminous panel as described in claim 1, **characterized in that** the second opaline plate (7) may be replaced by two opaline plates placed nearer to each other and to the first plate (1) thus reducing the panel thickness.

4. Luminous panel as described in claim 1, **characterized in that** the led series (2) are preferably located on two opposite edges of the transparent plate (1), though this will not exclude the utilization of a led series on only one edge or more than two series on three or four edges of the plate (1).

5. Luminous panel as described in claim 1, **characterized in that** the white paint (6, 6') or the reflecting and diffusing film is applied in alternating and staggered strips with other configurations on both surfaces of the first light conducting plate (1), thus causing the light to be reflected and diffused on both sides of the first plate (1), and in such case, two or four opaline plates (7,7') are provided , one or two on each side and also two transparent protective plates (8, 8') one on each side.

6. Luminous panel as described in claim 1, **characterized in that** the support (3) of the Led's (2) and the reflecting element (5) can be assembled away from the installation site by reciprocal jointing (14) and may be secured by a blocking element (15) so as to obtain a led sequence (2), the relevant supports (3) and reflecting elements (5) being perfectly aligned along the edges of the first transparent plate (1) which is particularly useful for large sized panels.

7. Luminous panel as described in claim 1, **characterized in that** the first transparent plate (1) is treated on its light diffusing surface, so as to create, instead of the paint coat or film (6), a geometrical pattern on this surface, obtaining areas reflecting the light towards the opposite side of the plate, alternating with non reflecting areas which allow the light to propagate inside the plate.

8. Luminous panel as described in claim 2, **characterized in that** the alternating pattern is obtained on both surfaces (19, 19') of the transparent plate (18) so that the light is diffused and reflected on both sides of the transparent plate (18) and in such case two second opaline plates (7, 7') are positioned on both sides of the transparent plate (18) together with two transparent protective third plates (8,8').

9. Luminous panel as described in claim 3, **characterized in that** the panel, if emitting light on both sides, may be darkened on one side by means of a blind wall preferably in paint coated aluminium, taking the place of the second opaline plate (7 or 7') and of the third protective plate (8 or 8').

10. Luminous panel as described in claim 1, **characterized in that** the framing sections (16, 20) are fabricated based upon the number and configuration of the various plates (1, 18, 7, 7', 8, 8'), on the processing and on the type of mat or transparent films as well as on the configuration of the led (2) supporting structure (3) and relevant reflecting elements (5), while it should be observed that these sections and their accessories should be preferably bright polished for a better preservation and diffusion of the led emitted light.

11. Luminous panel as described in claim 1, **characterized in that** suitable electronic components and earthing devices are provided to protect the panel against overvoltage and electrostatic discharges.

12. Luminous panel as described in claim 1, **characterized in that** the led's (2) are powered by the mains or by batteries (12) charged by a photovoltaic cell generator (13).

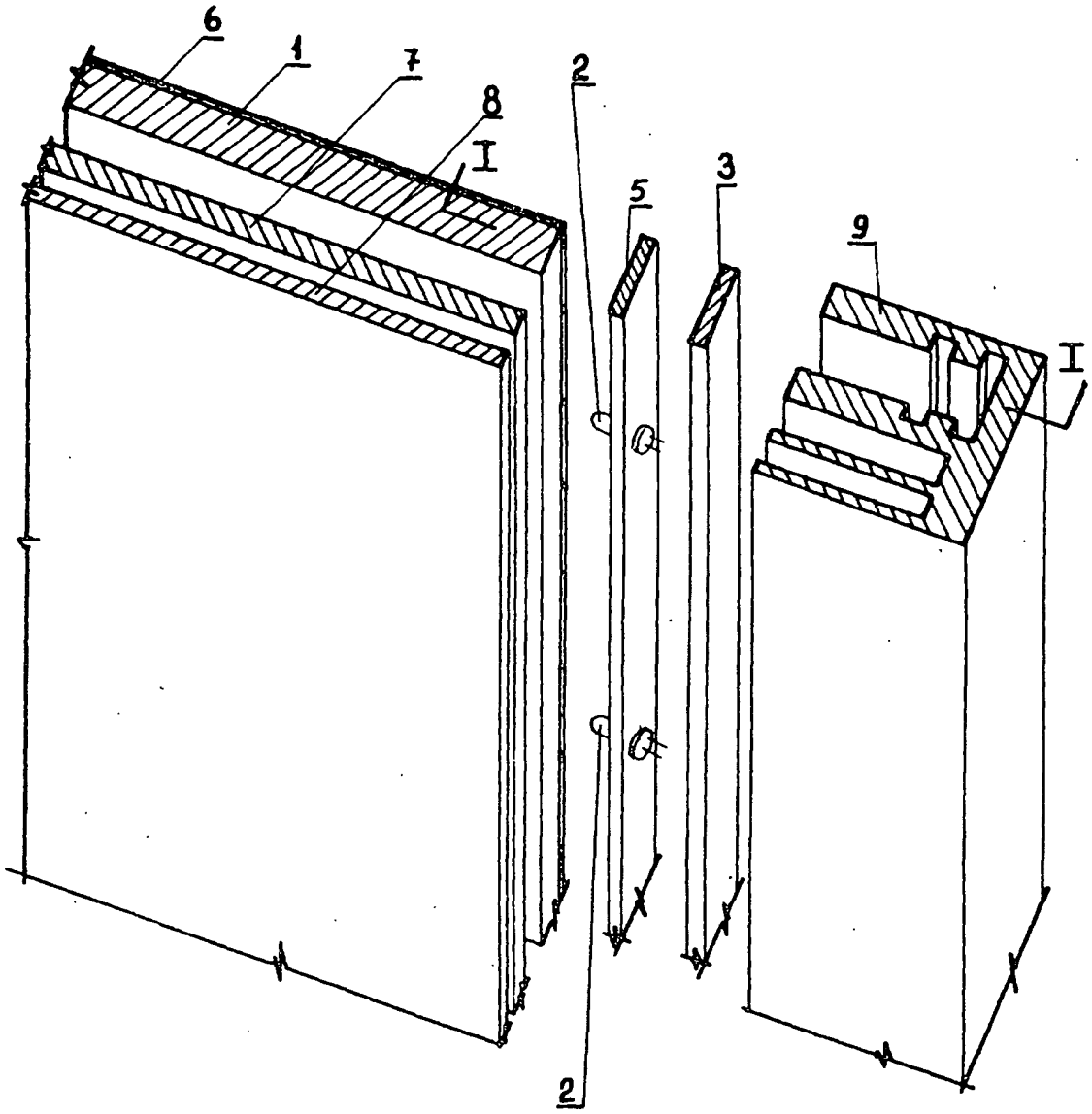

Fig. 1

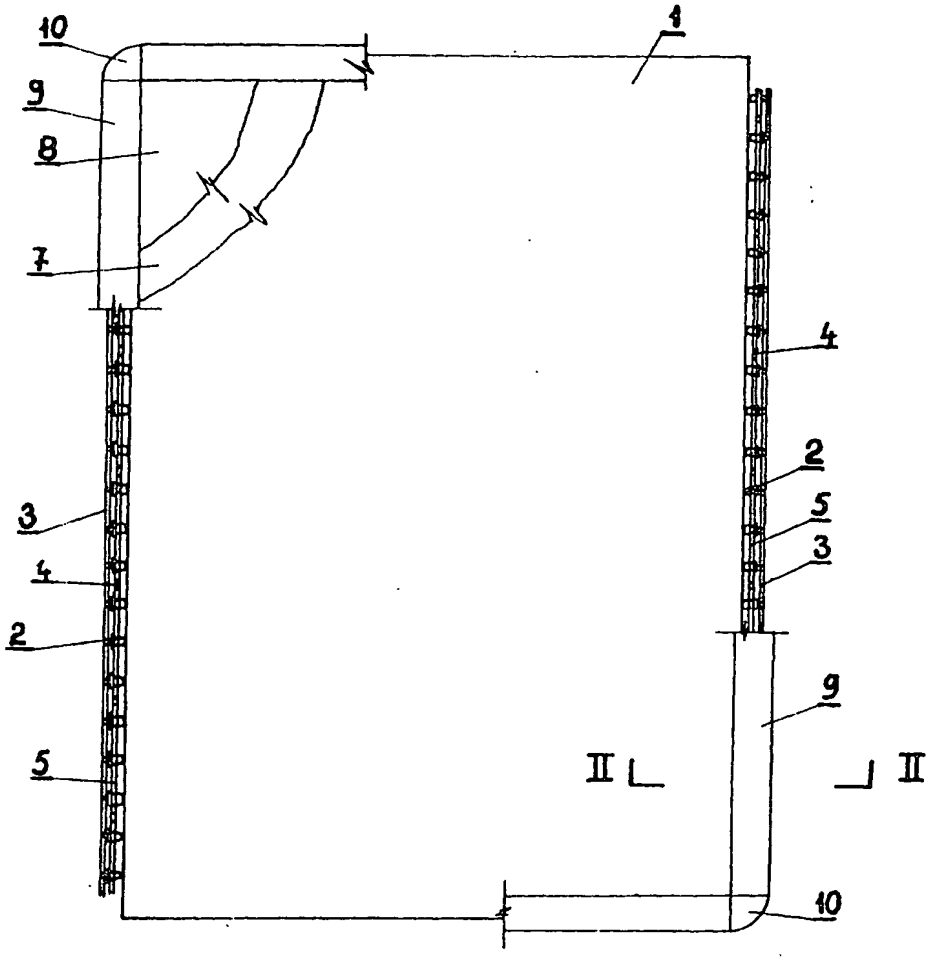

Fig.2

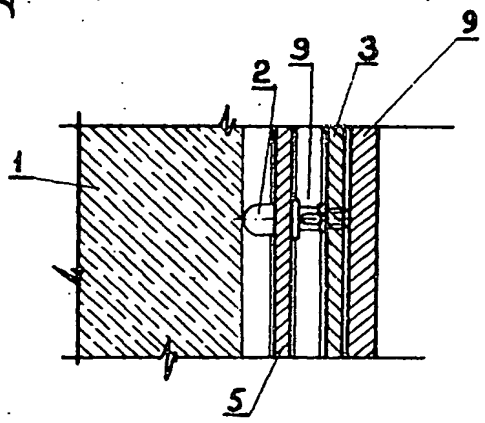

Fig.3

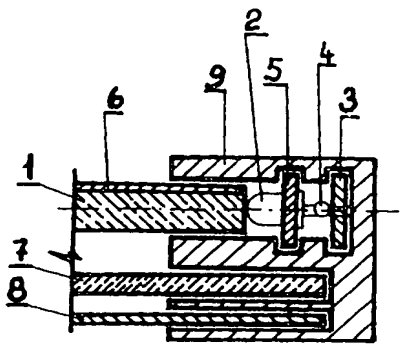

Fig. 4

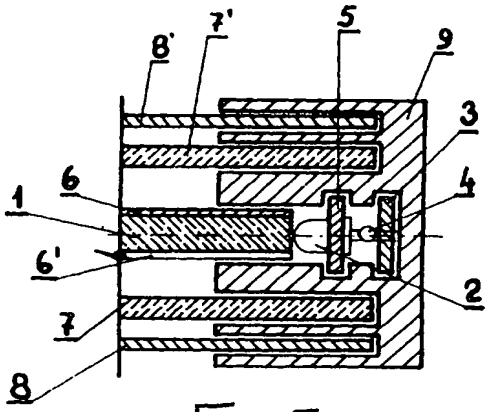

Fig. 5

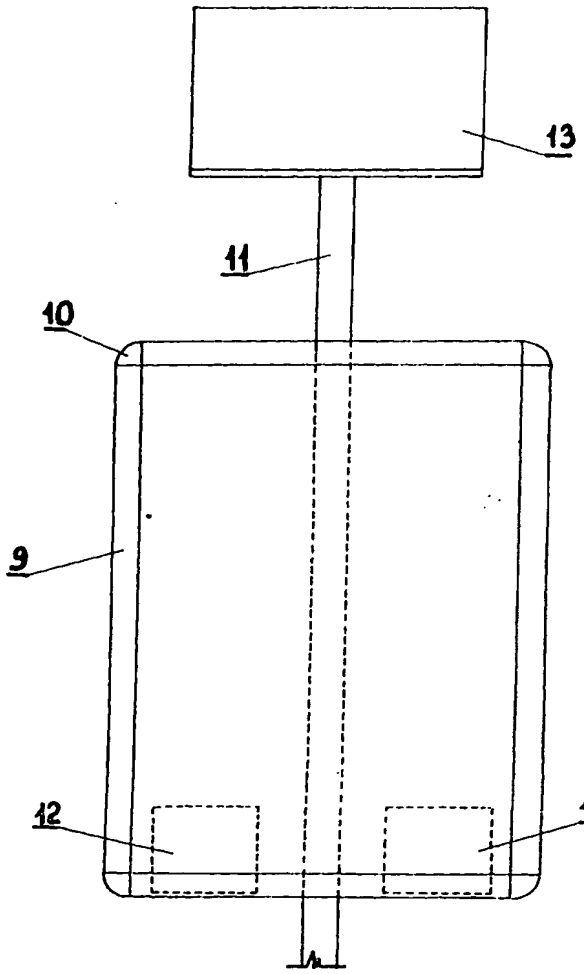

Fig. 6

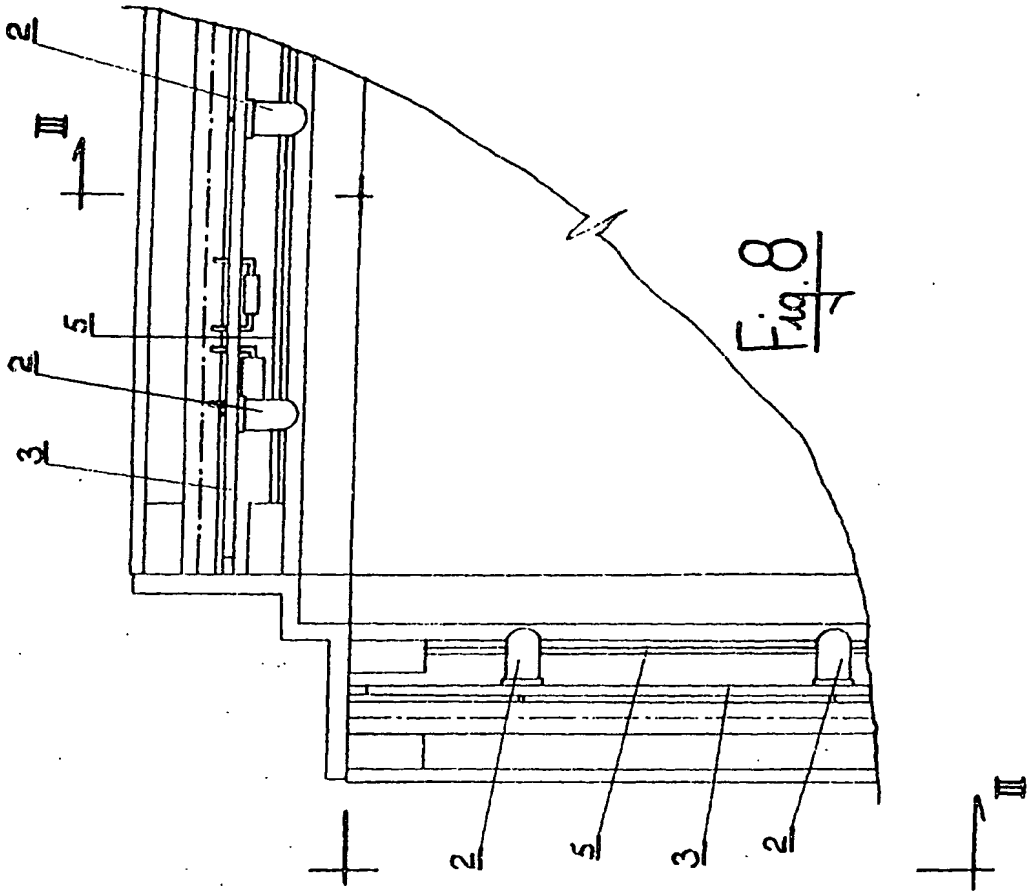

Fig. 8

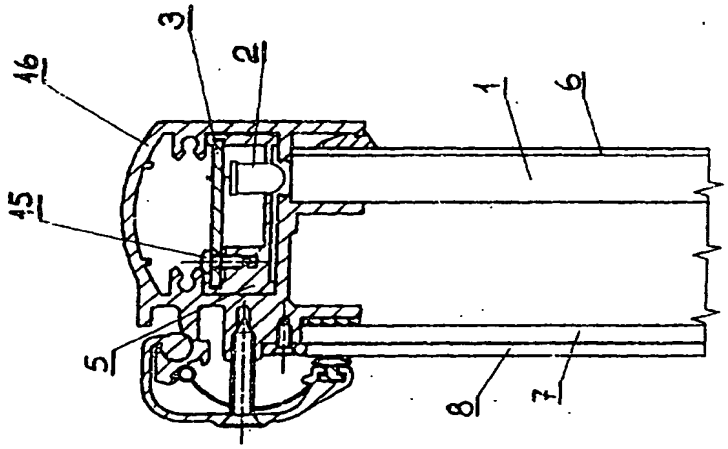

Fig. 7

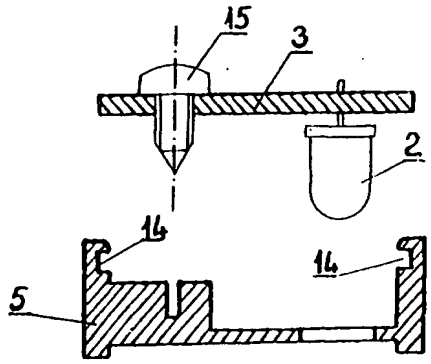

Fig. 9

Fig. 10

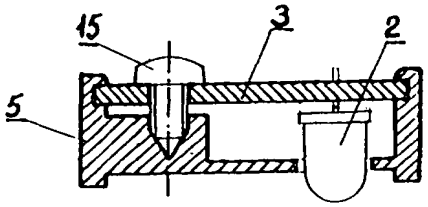

Fig. 11

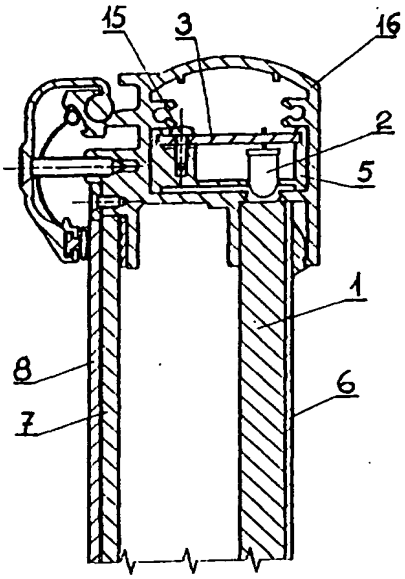

Fig. 12

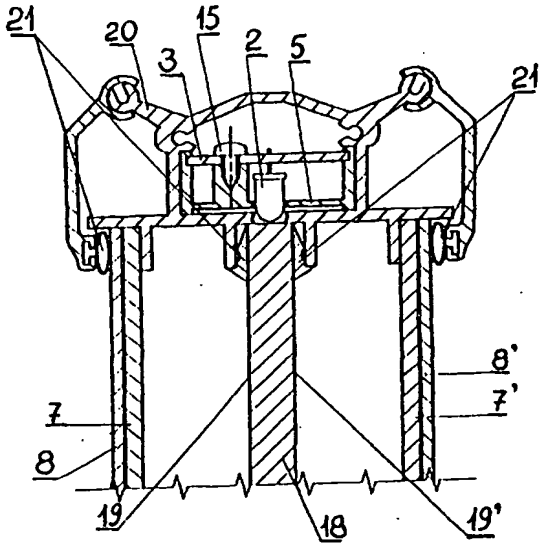

Fig. 13

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 11 1322

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	WO 99 51914 A (TELEDYNE LIGHTING AND DISPLAY PRODUCTS) 14 October 1999 (1999-10-14) * abstract; figures 1-13 *	1	F21V8/00
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			F21V

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 September 2001	Malic, K

CATEGORY OF CITED DOCUMENTS

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